ANALYSIS OF EFFECT OF BOTANICALS LIKE NIMBICIDINE, NEEMAZAL AND ACHOOK ON PESTS OF MAKHANA IN DARBHANGA REGION

Synopsis

Submitted in partial fulfillment of the requirements
for the award of Ph.D. degree
in Zoology,
Under the Faculty of Science,
Lalit Narayan Mithila University,
Darbhanga

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Title: Analysis of Effect of Botanicals like Nimbicidine, Neemazal And Achook on Pests of Makhana in Darbhanga Region

Introduction:

In recent years, global attention has increasingly turned towards sustainable agricultural practices as the need for food security and environmental conservation becomes more pronounced. Foxnuts, also known as Makhana, are the edible seeds of the lotus flower (*Euryale ferox*) and hold immense economic and cultural significance in various regions across the globe (Jha, V., et al. 1991). In India the main states involved in Makhana production include Bihar, Assam, Odisha, and West Bengal. Bihar is a major producer of Makhana in India, particularly in districts like Darbhanga, Madhubani, Samastipur, and Katihar. The state has a long-standing tradition of Makhana cultivation.

It's important to note that Makhana cultivation is traditionally associated with regions that have favorable wetland ecosystems, as the lotus plant, from which Makhana seeds are harvested, thrives in such environments. Additionally, efforts have been made to expand Makhana cultivation to new areas where conditions are suitable.

These nutritious seeds have gained popularity for their unique taste, rich nutritional content, and diverse culinary applications. However, the cultivation of Makhana is not immune to the challenges posed by pests, which can significantly impact both yield and quality. As the demand for Makhana continues to rise, addressing these pest-related challenges becomes imperative to ensure sustained productivity and environmental health.

This research proposal seeks to embark on a comprehensive analysis of effects of botanicals like Nimbicidine, Neemazal And Achook on the key pests affecting Makhana cultivation.

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This analysis aim to enhance the resilience of this crop against pest infestations while minimizing the ecological footprint associated with conventional pest control methods.

The key pests targeted in this study include insects, such as borers and weevils (beetle), which have been identified as major pests affecting foxnut crops.

Pest types affecting Foxnuts:

1. Makhana Phyllophaga Beetle (MPB): The Makhana Phyllophaga Beetle is a primary pest that infests foxnut crops, causing damage to both the foliage and the seeds. Understanding the molecular mechanisms underlying the interaction between the MPB and foxnuts is crucial for developing effective management strategies.

2. Leafhoppers and Aphids: Secondary pests such as leafhoppers and aphids can further exacerbate the damage caused by the MPB. These pests not only directly harm the plants but also serve as vectors for various plant diseases, posing additional threats to foxnut cultivation. (Paras, N., et al. 2018).

Understanding the life cycles, behavior, and ecological interactions of these pests will form the foundation for the development of effective and environmentally friendly strategies. By incorporating botanical control methods, we aim to create a balanced and sustainable approach that mitigates the impact of pests on Makhana crops.

This research is not only significant for Makhana farmers but also contributes to the broader discourse on sustainable agriculture. As we strive to meet the growing demand for food while safeguarding our ecosystems, the development of tailored analytical strategies for Makhana cultivation serves as a noteworthy step towards achieving these dual objectives. Through this comprehensive study, we aspire to provide actionable insights that can be translated into practical, scalable solutions for farmers, policymakers, and agricultural practitioners involved in Makhana cultivation.

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Significance of Study:

The significance of the study on analysis of effect of botanicals like nimbicidine, neemazal and achook on pests of makhana in Darbhanga region extends across multiple dimensions, encompassing agricultural, ecological, economic, and societal aspects. This research holds paramount importance for the following reasons:

1. Enhanced Agricultural Productivity:

Implementing effective strategies tailored to the specific pests affecting Makhana crops is poised to result in improved agricultural productivity. By minimizing the impact of pests on crop yields, farmers can achieve more consistent and higher-quality harvests, contributing to overall food security and economic stability in Makhana-growing regions.

2. Sustainable Agriculture Practices:

The study aligns with the global movement towards sustainable agriculture. Integrating pest management techniques, including biological controls and reduced chemical inputs, promotes environmentally friendly and ecologically sustainable farming practices. This shift towards sustainability is essential for preserving biodiversity, soil health, and water quality in Makhana cultivation areas.

3. Economic Viability for Farmers:

Makhana cultivation is often a primary source of income for many communities. By developing targeted pest management strategies, farmers can potentially reduce production costs associated with pest control while maintaining or increasing crop yields. This economic viability is crucial for the livelihoods of Makhana farmers, leading to improved socio-economic conditions in the region.

4. Preservation of Beneficial Organisms:

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Conventional pest control methods, such as broad-spectrum pesticides, can have detrimental effects on beneficial organisms, including pollinators and natural predators of pests. The development of specific pest management strategies minimizes the negative impact on these beneficial organisms, fostering a more balanced and resilient agro ecosystem.

5. Global Food Security:

As a valuable and nutrient-rich crop, Makhana contributes to global food security. Mitigating the impact of key pests through advanced pest management strategies ensures a stable and secure supply of Makhana, particularly considering the increasing global demand for diverse and nutritious food sources.

6. Adaptation to Climate Change:

Climate change poses unpredictable challenges to agriculture, including shifts in pest dynamics. This analysis will help in developing adaptable and flexible pest management strategies for Makhana allows farmers to better respond to changing climatic conditions, ensuring the resilience of the crop in the face of evolving pest pressures.

The significance of this study lies in its potential to foster a sustainable, economically viable, and resilient Makhana cultivation system that meets the needs of both present and future generations. By addressing the challenges posed by key pests, this research contributes to the overall well-being of agricultural communities, environmental conservation, and global food security.

Review of Literature:

Insect Pests Affecting Foxnuts:

Previous studies have identified several insect pests that pose a threat to foxnut cultivation. Common pests include beetles, caterpillars, and mites. Understanding the specific

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interactions between these insects and foxnut plants is crucial for developing targeted management strategies.(Paras, N., et al. 2018).

Breeding for Insect Resistance:

Research on breeding programs focused on enhancing insect resistance in foxnut varieties has gained attention. Understanding the genetic basis of resistance and utilizing molecular markers facilitate the development of cultivars with improved pest resistance (Douglas, A.E. 2018).

Biological Control Strategies:

Studies on the implementation of biological control measures, such as the introduction of natural enemies, have emphasized their effectiveness in managing insect pests in foxnut cultivation. Assessing the ecological impact of these measures is critical for their sustainable integration (Van Driesche, R. et al. 2009).

Natural Control Strategies:

Nimbicidine proves to be the most efficient Neem formulation, surpassing Neemazal and Achook in effectiveness. Neemazal, as previously mentioned, also demonstrates control over aphid populations, ranking second in terms of efficacy. Achook is identified as another effective Neem product in managing some aphids. However, the current study results position Nimbicidine and Achook as the fourth and fifth most effective, respectively. Additionally, the observations indicate that Neemgold exhibits the least effectiveness in controlling aphids (Rani, T. et al. 2019).

Integrated Pest Management (IPM) Approaches:

Integrated Pest Management (IPM) strategies, combining cultural, biological, and chemical control methods, have shown promise in maintaining sustainable foxnut cultivation. The

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holistic approach of IPM addresses the multifaceted challenges posed by insect pests (Ehler, L.E. 2006).

Molecular Mechanisms of Plant Defense:

Investigations into the molecular mechanisms activated in foxnut plants in response to insect infestation have highlighted the role of various signaling pathways and gene expression changes. Identification of key genes involved in plant defense can provide a foundation for molecular breeding programs (Boller, T. and F. Meins 2012).

Metabolomic Profiling of Infested Foxnuts:

Metabolomic studies have explored alterations in the biochemical composition of foxnuts following insect attacks. Changes in secondary metabolites, including flavonoids and alkaloids, have been observed, influencing the nutritional quality and potential health benefits of the seeds (Bao, K., et al. 2022).

RNA Sequencing Studies:

Advancements in RNA sequencing technologies have allowed researchers to conduct comprehensive transcriptomic analyses of foxnut plants during insect infestation. These studies have revealed dynamic changes in gene expression profiles and provided insights into potential targets for genetic improvement (Liu, X. et al. 2018).

Community Engagement and Sustainable Agriculture Practices:

Studies highlighting the importance of community engagement and education in promoting sustainable foxnut cultivation practices have been instrumental. Empowering local communities with knowledge about pest management fosters a collaborative and environmentally conscious approach (Matteson, P.C., et al. 1994).

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The literature reviewed underscores the diverse approaches taken to develop Integrated Pest Management Strategies for key pests in Makhana cultivation. These studies collectively contribute valuable insights to the ongoing efforts aimed at securing the future of foxnut cultivation in the face of insect-related challenges.

Objectives:

1: Field Studies

- Gathering and Identifying insect pests in Darbhanga region.
- Investigating comprehensive control methods of pest in makhana crops across Darbhanga.

2: Laboratory Studies

- Cultivating the chosen insect pests within the laboratory setting.
- Investigating the life cycle, reproduction, feeding habits and host specificity of selected pests.
- Conducting experiments with nimbicidine, neemazal and achook on pests of makhana.
- Examination of the histological sections of digestive system to observe any morphological changes or damage to the system caused by neem botanicals.

Proposed Methodology:

Analysis of effect of botanicals like nimbicidine, neemazal and achook on pests of makhana in Darbhanga region involves a systematic approach and goals to minimize the impact of pests while promoting sustainable and environmentally friendly practices. Below is a work plan and methodology for the development of IPM strategies:

1. Preliminary Assessment, Pest Identification and Characterization of pest:

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- Conducting a thorough survey of makhana fields in the Darbhanga region to identify prevalent pest species and their distribution.
- Documentation of the types of pests, their population densities, and the extent of damage caused.
- Analysis of pest infestation on makhana in March, June, September and December to have idea of seasonal variation.

2. Cultivation of the Insect pest in lab:

- Cultivating the chosen insect pests within the laboratory setting through Habitat Mimicry with similar Host Plants.
- Proper Containment and Monitoring to sustain pest populations.
- Research-Based Feeding with measures to prevent overpopulation and maintain manageable pest numbers for experimentation.

3. Procurement of Botanicals:

- Botanicals like Nimbicidine, Neemazal, and Achook will be purchased from local supplier.

4. Analysis of Botanicals on insect pest:

- Determining the appropriate dosage and application method for each botanical based on label instructions and previous research.
- Applying the botanicals uniformly to the culture media where pest are being grown.
- Monitoring mortality rates over a specified period and calculate LD50 (for lethal dose) and LC50 (for lethal concentration) using appropriate statistical methods.
- Adhering to safety precautions during application to prevent harm to humans and the environment.

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5. Biochemical Studies:

(i) On Digestive Enzyme:

- In the laboratory, controlled conditions ensure uniformity in pest age and nutrition. Pest populations are divided into treatment and control groups for exposure experiments using different botanical concentrations. Samples will be collected post-exposure, ensuring integrity and minimal stress. Extracted samples will undergo homogenization to isolate key digestive enzymes, followed by biochemical assays to quantify activity levels. Statistical analysis will compare treatment and control groups to identify significant differences. Findings will be interpreted within pest physiology and botanical effects, informing pest management strategies. Results will be validated through replication and potentially corroborated with other assays.

(ii) On alkaline phosphatise (ALP)

- ALP activity will be measured using colorimetric assays. The enzyme catalyzes the hydrolysis of phosphate groups from various substrates at an alkaline pH. A common substrate for ALP assay is p-nitrophenyl phosphate (pNPP), which turns yellow when cleaved by ALP. Data will be collected through the rate of colour development which is proportional to the enzyme activity and can be measured spectrophotometrically.

(iii) Protein estimation

- Total protein content in the insect tissues will be determined using various biochemical assays such as the Bradford assay, Lowry assay, or Bicinchoninic Acid (BCA) assay. These assays rely on the reaction of proteins with specific reagents to produce colorimetric or fluorescent signals that can be quantified using a spectrophotometer.

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(iv) Antioxidant analysis

- Antioxidant activity in insect tissues will be assessed through any method such as measuring the scavenging activity against free radicals (e.g., DPPH assay), determination of total antioxidant capacity (e.g., FRAP assay), or measurement of specific antioxidant enzymes (e.g., superoxide dismutase, catalase).
- These assays typically involve incubating the insect tissue extracts with specific reactive species or substrates and measuring the decrease in absorbance or other relevant parameters indicative of antioxidant activity.

6. Histological Studies:

- Conducting histological studies to investigate the effects of neem botanicals (nimbicidine and neemazal) on pests.
- Collecting samples of pest species exposed to neem botanicals and control groups.
- Processing the samples for histological analysis, including fixation, embedding, sectioning, staining, and microscopy.
- Examining the histological sections of digestive system to observe any morphological changes or damage to system caused by neem botanicals.

7. Data Analysis:

- Analyze the collected data using appropriate statistical methods, such as ANOVA or regression analysis.
- Compare pest populations and crop damage levels between treatment and control plots to assess the effectiveness of botanical treatments.
- Incorporate LD50 and LC50 values into the analysis to evaluate the toxicity of botanicals to pest populations.

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8. Interpretation of Results:

- Interpret the findings to determine the overall impact of nimbicidine, neemazal, and achook on pest control in makhana cultivation.
- Assess the relationship between botanical efficacy, pest mortality rates, and environmental factors.
- Discuss the histological findings regarding the effects of neem botanicals on digestive system morphology and internal structures of pest.

Expected Outcomes:

The anticipated outcomes of the research on analysis of effect of botanicals like nimbicidine, neemazal and achook on pests of makhana in Darbhanga region are multifaceted and hold significant implications for agricultural, ecological, and socio-economic domains. The expected outcomes include:

1. Histological examination of insect pests' digestive systems post-exposure to Nimbicidine, Neemazal, and Achook is expected to reveal disruptions in cellular structure, epithelial layer damage, and morphological alterations in digestive organs.

2. Comparative analysis among botanical treatments is anticipated to reveal variations in their effects on insect digestive system histology, with Nimbicidine potentially exhibiting distinct changes attributed to its potent insecticidal properties.

3. Examination of cellular responses post-treatment is expected to reveal indicators like apoptosis, necrosis, or inflammation, signaling activation of defense mechanisms.

4. Histological analysis aims to identify specific target sites affected by botanical treatments, elucidating their mode of action.

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5. Correlation between histological alterations, pest mortality rates, and feeding behavior suggests effective botanical treatments induce significant histopathological damage, reducing insect viability and altering feeding patterns.

In conclusion, the analysis of the insect pests after treatment with botanicals like Nimbicidine, Neemazal, and Achook holds the promise of providing crucial insights into their efficacy, target sites, and potential applications in pest management strategies for foxnut cultivation.

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